GLACIAL LAKE SEDIMENTS IN UPPER CLEAR CREEK VALLEY, SOUTHCENTRAL FAIRFIELD COUNTY, OHIO

by

Michael Mitchell

As a fulfillment for Geology 570
and as a partial fulfillment for
the requirements of a degree of
Bachelor of Science in geology.

1969

Advisor
Sidney E. White
Dr. Sidney E. White

Table of Contents

List of Figures

1. View from Landis Road at
Clear Creek, north

2. View from Landis Road at
Clear Creek, south

3. View from Landis Road at
Clear Creek, west

4. View from Landis Road at
Clear Creek, east. Note
large amount of gravel in
Clear Creek.

Abstract

A study of the soil types and cores taken in a portion of southwestern Fairfield County indicates the presence of glacio-lacustrine silts and clays in the Clear Creek Valley from Clear-port, northwest, to Amanda. Mollusc shells found buried in the deposits of silty clay are fresh water forms and of mid-Pleistocene to present in age. However, the fact that these shells were buried in a matrix of late Pleistocene origin, indicates that they are of that age.

The sediments decrease in coarseness away from the dam and decrease in coarseness from the edges to the center of ancient lake deposits.

The deep cores obtained indicate that an average of 18 feet of silts and clays have accumulated. Amount of material varies widely from one core to another. These cores also indicate an interbedding of till or coarse deposits with lacustrine deposits, suggesting that several lakes existed in this area during the Illinoian and Wisconsin stages.

Scope and Methods

The purpose of this project was to map in detail the glacio-lacustrine silts and clays of Wisconsin age in Clear Creek Valley between Clearport and Amanda in southwestern Fairfield County. Also included in the scope of this project was correlation of these lake deposits with present day soil types, in order to determine the exact location of the outwash dam and to determine the boundaries of the lake prior to breaching the outwash dam.

The field work was accomplished between July 10, 1969, and October 7, 1969. Mapping was done by aerial photographs, soils maps and by the presense of lake deposits in stream cuts and cores. Cores were taken with a four inch barrel type hand auger. The maximum depth attainable by this method was ten feet. The Ohio State University Geology Department made it possible to do a limited amount of augering with a University Jeep mounted auger. (Photograph 5) With this device, forty foot depths were attainable.

These cores and samples were taken in an attempt to correlate lake deposits, to find Pleistocene Mollusc, and possibly buried wood, and to describe the composition of the lake deposits.

Acknowledgements

The author wishes to thank the Lands and Soils Division, Department of Natural Resources, State of Ohio for their help in obtaining soils information, the Department of Water Resources, Department of Natural Resources, the State of Ohio for making available their well log files. The Friends of Orton Hall provided financial support for the cost of maintenance and operation of the Jeep mounted auger. The Jeep was supplied by the Department of Geology, Ohio State University. The author wishes to specifically thank Mr. R. Walters and Mr. E. Strickler for their permission

5. Jeep Mounted Auger

to drill on their land; Jerome Lemire and Marc Hoyer for their help as field assistants; Aurèle La Rocque, Department of Geology, Ohio State University, for his assistance in identifying Pleistocene Mollusca and Sidney E. White, Department of Geology, Ohio State University, who was my advisor.

Previous Work

In 1956 James F. Conley published a Master's Thesis on the glacial geology of Fairfield County. In 1962 a bulletin was published concerning the geology of Fairfield County (Wolfe, Forsyth, Dove). Jane Forsyth did the glacial geology section which enlarged on Conley's earlier work and included a 1:62500 scale map of the glacial features of the county. Wilber Stout, Karl Ver Steeg and G. F. Lamb published a paper in 1943 outlining the general drainage history of the State of Ohio; this is helpful in reconstructing the evolution of Clear Creek.

Physiographic Setting

Clear Creek and its tributaries drain into the Hocking River and eventually into the Ohio River. The maximum variation in relief in this area is 320 feet.

The area can be divided into two physiographic sections, the Till Plain and the Glaciated Allegheny Plateau (Wolfe, 1962).

The Till Plain includes parts of Clear Creek and Amanda Townships in which the bedrock surface has been obscured by drift. The surface is youthful, gently undulating, and in general, poorly drained. The Till Plain and the Glaciated Plateau are, in general, separated by an escarpment (Wolfe, 1962).

The Glaciated Allegheny Plateau contains the sites of bedrock highs forming the divides of the Preglacial surface (Figure 1).

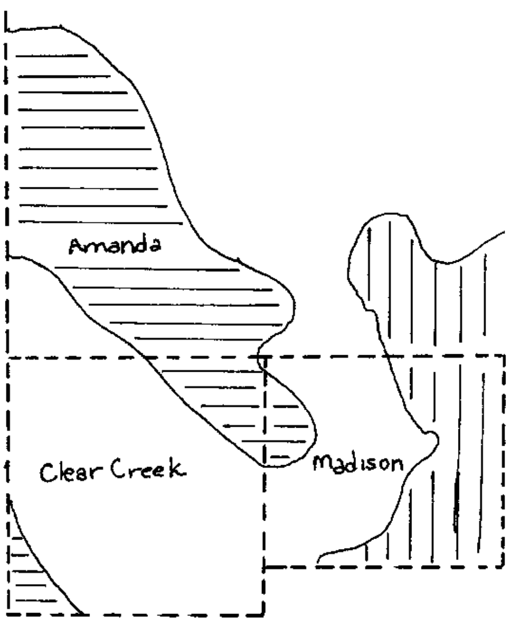


Figure 1

Physiographic Sub-divisions
(Wolfe,1962)

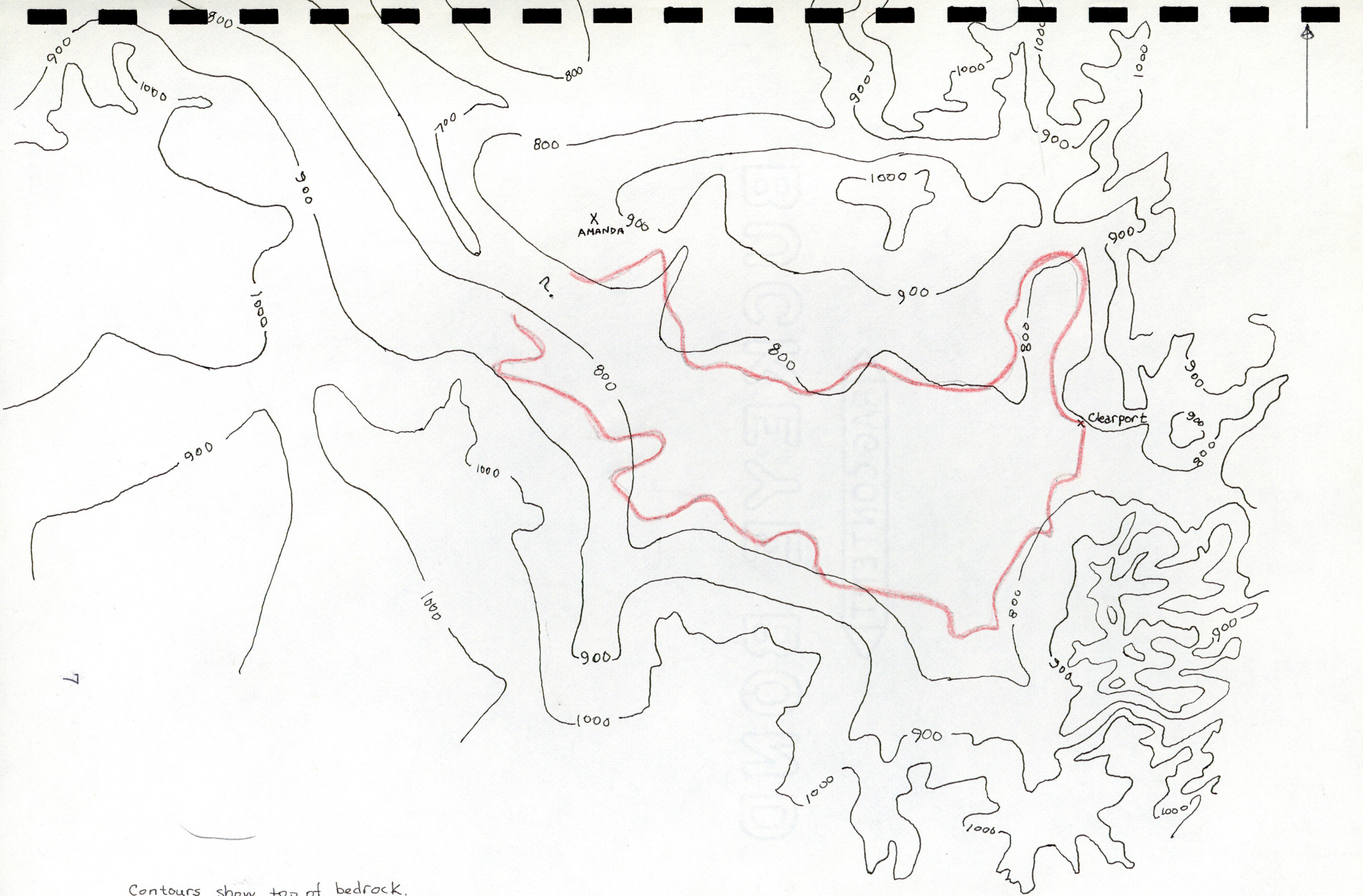
Till Plain
Glaciated
Unglaciated

Geographic Setting

The area of study lies in the Amanda, Clearport, and East Ringold Quadrangles, 7.5 minute series of southwestern Fairfield County, Ohio. The extent of study included 20 square miles, extending to the Wisconsin ice border and about two miles inside the Illinoian border.

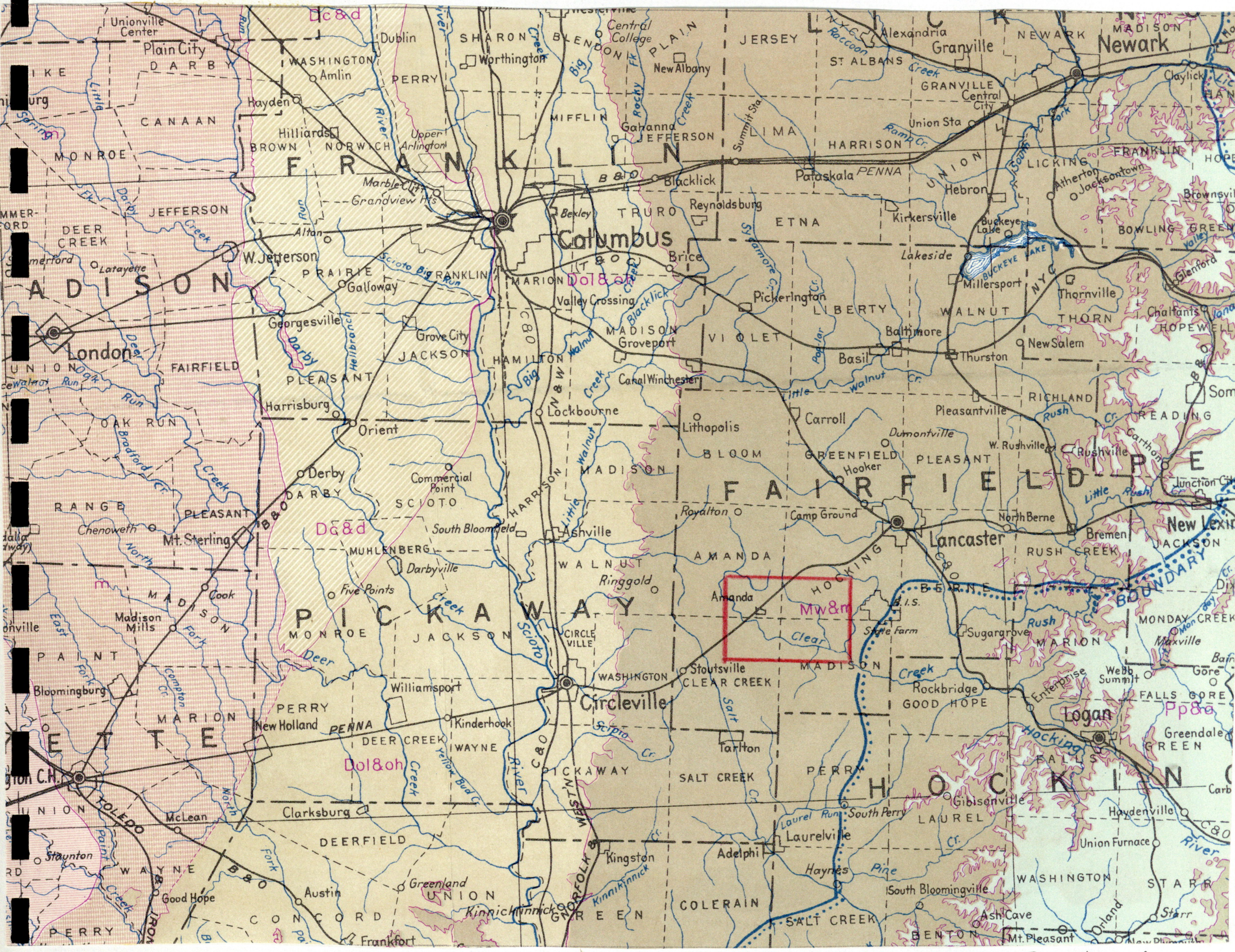
Geology of the Area

The bedrock surface on which the glacial sediments rest unconformably is Mississippian in age and is composed mostly Sunbury share, Cuyahoga formation sandstones and the Berea sandstone (Conley, 1957). The depth to bedrock varies from 60 to 150 feet in this area. It can be seen from the Geologic Map that the valley of Clear Creek is cut in bedrock. (Figures 2 and 3).



Contours show top of bedrock.
East of Clearport bedrock forms the hills,
West of Clearport bedrock lies under glacial deposits.
Ancient LAKE EXTENT. Shown in red.

Geological MAP
1:62500
WoLFE, 1962



Silurian Devonian MISSISSIPPIAN PennsylvANIAN

Geologic Map showing Bedrock Age.
Area of this study shown in red.

Drainage Evolution

The bedrock valley in which Clear Creek flows was developed before or as part of the Teays Drainage System (Stout, 1938). At that time the Creek was divided into two individual streams separated by a steep divide east of the Fairfield-Hocking County line in Madison Township. During the Teays Stage, the eastward flowing creek (Thomas Run) emptied into the Logan River. The northwestard segment emptied into the Laurelville Creek.

During the Deep Stage, the eastward segment emptied into the Lancaster River, the westward segment into the Newark River (Figure 4).

The Illinoian stand of ice caused the divide to be breached because the ice sheet covered most of the old westward flowing drainage. Evidence for this comes from the Illinoian outwash terraces occurring in in Clear Creek Valley east of the old divide (Forsyth, 1962). (Figure 5)

The Wisconsin ice sheet later covered the old drainage system as far east as Clearport. An outwash dam formed at Clearport where the bedrock constricted causing a lake to be formed west of the dam.

The moraine, 2.5 miles west of Clearport, is part of the New Salem Moraine. Because the soils developed on this moraine are Alexandria Series, a relatively young soil type, the moraine is considered to be a late Wisconsin recessional moraine or a slight advancement of the then retreating ice sheet. The relative age for this is fixed between 21,000 and 15,000 years before present (Forsyth, 1962)

It seems likely that Illinoian drift and possibly Illinoian lacustrine deposits lie below the Wisconsin deposits. However, without a better coring device which could go to bedrock and then a way to date the sediments, this can not be proven.

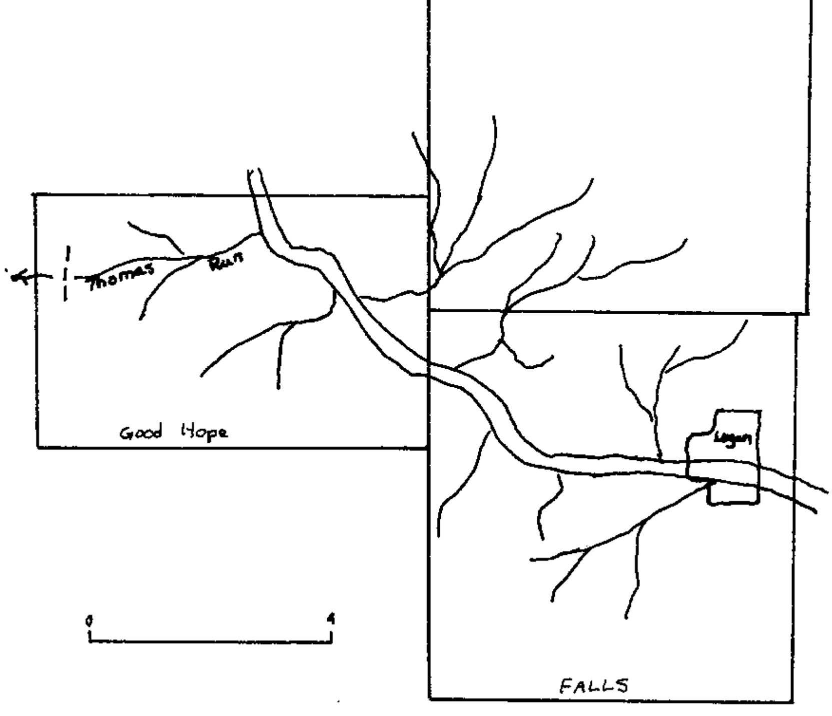


Figure 4

Pre-Illinoian Drainage
(Merrill,19)

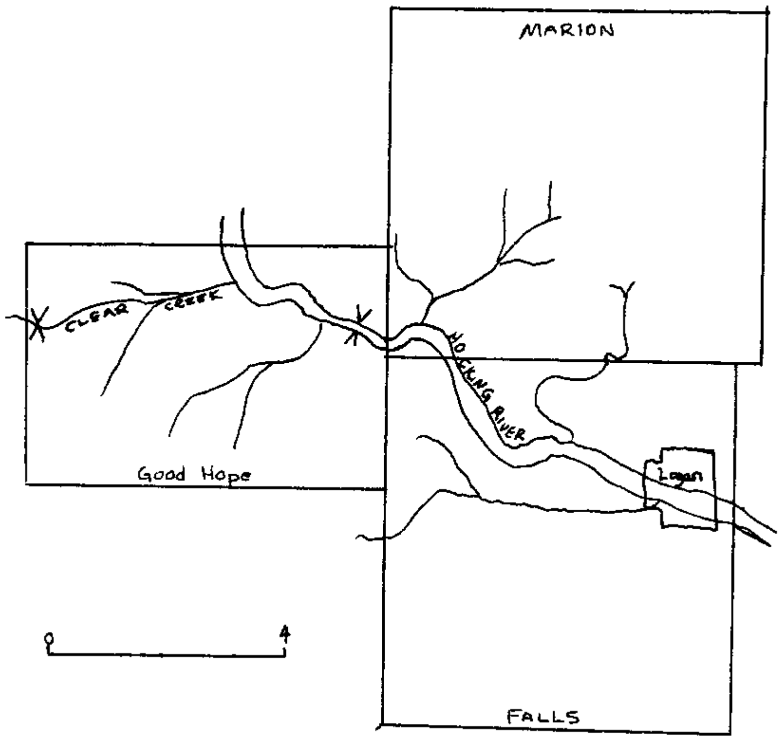


Figure 5
Post-Illinoian Drainage
(Merrill,19)

Lake History

As the Wisconsin glacier retreated, outwash was deposited in the valley and collected at Clearport where it formed a dam. Meltwater and the normal drainage of the area provided a source for the lake waters, which accumulated behind the dam to the west of Clearport.

The moraine represents an advance of the ice sheet after the glacier had begun retreat, or it represents a recessional moraine. In either case, this would indicate that a lake stood behind the moraine, as the moraine probably was at one time connected to the morainal series known as the New Salem Moraine, which extend into the lake area. This second dam of meltwater existed either contemporaniously with the first lake or existed after the first lake had drained. Without a method of dating the lake sediments, which possibly could have been done by pollen analysis or radiocarbon methods, it is not possible to confirm this hypothesis.

Depth of valley and the sediments

As previously pointed out, the valley which the lake occupied was a result of previous drainage.

The bedrock surface of the valley ranges from 850 to 750 feet in elevation (Wolfe, 1962). The present valley floor lies between 840 and 900 feet. Calculations show that the average depth to bedrock is 74 feet. The sediments here probably comprise Wisconsin and Illinoian deposits.

The Illinoian deposits range from 2-10 feet (Stout, 1948) in thickness in this area. Considering the problem of erosion in the valley, it seems likely that most of the Illinoian deposits were eroded. The problem with this hypothesis is that this would leave alot of sediment to be accounted for by Wisconsin deposition. If there are Illinoian deposits, they rest directly on the bedrock surface and again, according to Stout, they were originally up to 75 feet in depth.

No estimate of the amount of Wisconsin till in this area can be made; however, it does seem likely that either till or outwash in significant quantities does occupy the valley, above the Illinoian and either under, interbedded with or over the Wisconsin lacustrine deposits.

Extent of the lake

The water level was determined by examining the elevation of the terraces in the area, which have been cut up to 900 feet in elevation, and by examining the lacustrine deposits present in the cores. There were lacustrine deposits in cores as high as 905 feet in elevation and it seems therefore likely that this was the highest water level. The cores at this level contained a lot of sand interbedded with the lake silts, indicating that this was a beach area deposit.

Deposition of Lacustrine Silts and Clays and the Length of Stand of the Lake

The rate of sedimentation was probably significantly faster than today due to the outwash coming from the retreating glacier. This would account for the fact that there are large quantities of silt and clay sized particles in these lacustrine deposits which, because of their size, normally require a length of time in which to settle out. Naturally, there is a large amount of sand and gravel in these deposits and this comes from the glacier also; however these sediment pose a different problem and were out of the scope of this project.

The lake probably did not exist for a significantly long period of time. The outwash dam was made of unconsolidated sand and gravel which would have been eroded rapidly by water action. The fact that there was such a large amount of water present from the normal drainage and the meltwater from the glacier would have speeded this erosion process. However, without a means of dating the deposits of the lake, it is impossible to predict the actual length of time this glacial lake existed.

Erosion of the lake silts

After the dam and or moraine was breached, Clear Creek resumed its Post-Illinoian drainage pattern, as it flows today. This dam was breached at its southern end, where the bedrock hills and the outwash were in contact. The reason for this probably is that there was greater water action at this end of the dam.

As the lake deposit map shows (Plate 1), the lacustrine deposits were heavily eroded, especially on the northern edge of the valley, by the meltwater and the subsequent drainage of Clear Creek.

Characteristics of Soil Development

The major diagnostic characteristic of lake silts, which can be used in their mapping, is the soils that develop upon them. Soil is formed by weathering and the characteristics of a soil at any place are functions of (1) the climate under which the parent material has existed since deposition, (2) the organic activity in the soil, (3) the relief of the surface on which the soil is developing, (4) the length of time that the soil has had to develop, (5) the composition of the parent material. (Meeker, Petro, Bone, 1960)

Since the area encompassed by this project was small, the climate factor and the organic factor can be assumed to be constant. (Therefore, the soils that are seen today are functions only of time, relief and parent material.)

It is therefore possible to distinguish between late Wisconsin lake silts and other material deposited by the glacier.

The soils which have developed over the lacustrine silts and clays are combined in various patterns on the valley floor. The fact that the same soil did not develop over all the lake silts and clays can be explained by saying that some of the deposits are stratified, or calcareous, with differing amounts of other outwash incorporated with them and these minor differences in parent material give rise to the different soils (Meeker, Petro, Bone 1960).

Soil Types occuring over Late Wisconsin Silts and Clays

The following is a listing of the dominant soil types developed on the late Wisconsin lacustrine deposits. All soils data from Meeker, Petol, Bone, 1960 Soil Survey.

Algiers Silt Loam

Poorly drained Alluvial soils. Derived from Wisconsin glacial till and associated with the Westland and Montgomery Soils.

Carlisle Muck

Very poorly drained black organic soils derived from vegetation that accumulated in Wisconsin ponds and lakes.

A typical profile follows:

0-20" black granular muck, contains decayed plant material
20-36" black and dark reddish-brown, grades into peat
36- dark olive-gray firm silty clay, underlain by gravel at varying depths

Fitchville Series

These are somewhat poorly drained soils that are Gray-Brown Podzolic of Red-Yellow Podzolic soil groups. They are developed on terraces over lacustrine noncalcareous silty and clayey materials of Wisconsin age. They are associated with McGary soils and they have the same profile, the difference being that the McGary soils develop over calcareous material.

McGary Silt Loam

These are poorly drained Gray-Brown Podzolic soils which developed from calcareous, lacustrine silty and clayey deposits of Wisconsin age. A typical profile follows:

0-7" dark grayish-brown friable silt loam, moderate to weak fine granular structure, slightly acid
7-15" mottled light-gray and light yellowish-brown firm silty clay loam, medium fine angular blocky and subangular blocky structure, medium acid
15-32" mottled gray and pale-yellow firm silty clay loam, strong coarse to medium angular blocky
32- mottled light brownish-gray, brownish-yellow and gray firm silty and clayey materials, thinly laminated

Montgomery Silty Clay Loam

These are dark-colored, very poorly drained Humic Gley soils that developed over lacustrine calcareous clayey and silty materials of Wisconsin age. They occur on terraces which are covered with lacustrine deposits. A typical profile follows:

0-8" very dark gray to black, firm to friable silty clay loam, moderate medium to find granular structure

8-15" dark brownish-gray, firm silty clay loam, moderate to strong medium angular blocky structure
15-24" dark-gray firm silty clay loam with distinct yellowish-brown mottles
24-54" mottled dark-gray firm silty clay,moderate to coarse angular blocky structure
54- mottled light olive-brown and gray very firm silty clay

Sebring Series

These soils are poorly drained Planosols developed on terraces over noncalcareous, stratified lacustrine silty and clayey materials of Wisconsin age. These soils are associated with the McGary series and their profile is quite similar to the McGary profile already presented.

Westland Silty Clay Loam

These consist of dark-colored, poorly drained Humic Gley soils developed on lacustrine silty and clayey and find loamy materials which overlie stratified gravel and sand or outwash terraces of Wisconsin age. A typical profile follows:

0-8" very dark gray to black friable to firm silty clay loam, moderate medium granular structure, some organic content
8-12" black to very dark gray firm fine clay loam to silty clay loam, moderate medium to coarse granular structure
12-45" mottled gray, pale-yellow, and dark-gray firm clay to clay loam and some gravelly material, moderate medium angular blocky and subangular blocky structure
45 - gray and pale-yellow stratified silty, sandy and gravelly materials

Core Explanation

The cores are divided into three sections: (1) Jeep-auger, (2) hand auger cores, (3) cores taken from the files of the Ground Water Division, Department of Natural Resources, State of Ohio. The reason for this division is that the Jeep auger tended to mix the samples to a certain extent, while the hand auger cores were much more exact in relating depth to the sample obtained. The cores from the Water Resources Department were submited by private drilling operators and because of the incomplete descriptions and broad generalizations of the operators, these can only be used in a very general way.

Several cores were attempted in the Clear Creek stream area, however, these were not considered conclusive because of the presence of gravel at shallow depths. The hand auger was not able to penetrate these deposits.

Page 19 is blank in the original 1969 Senior Thesis by Michael Mitchell. NOTE: There are also two page 7 in the original document.

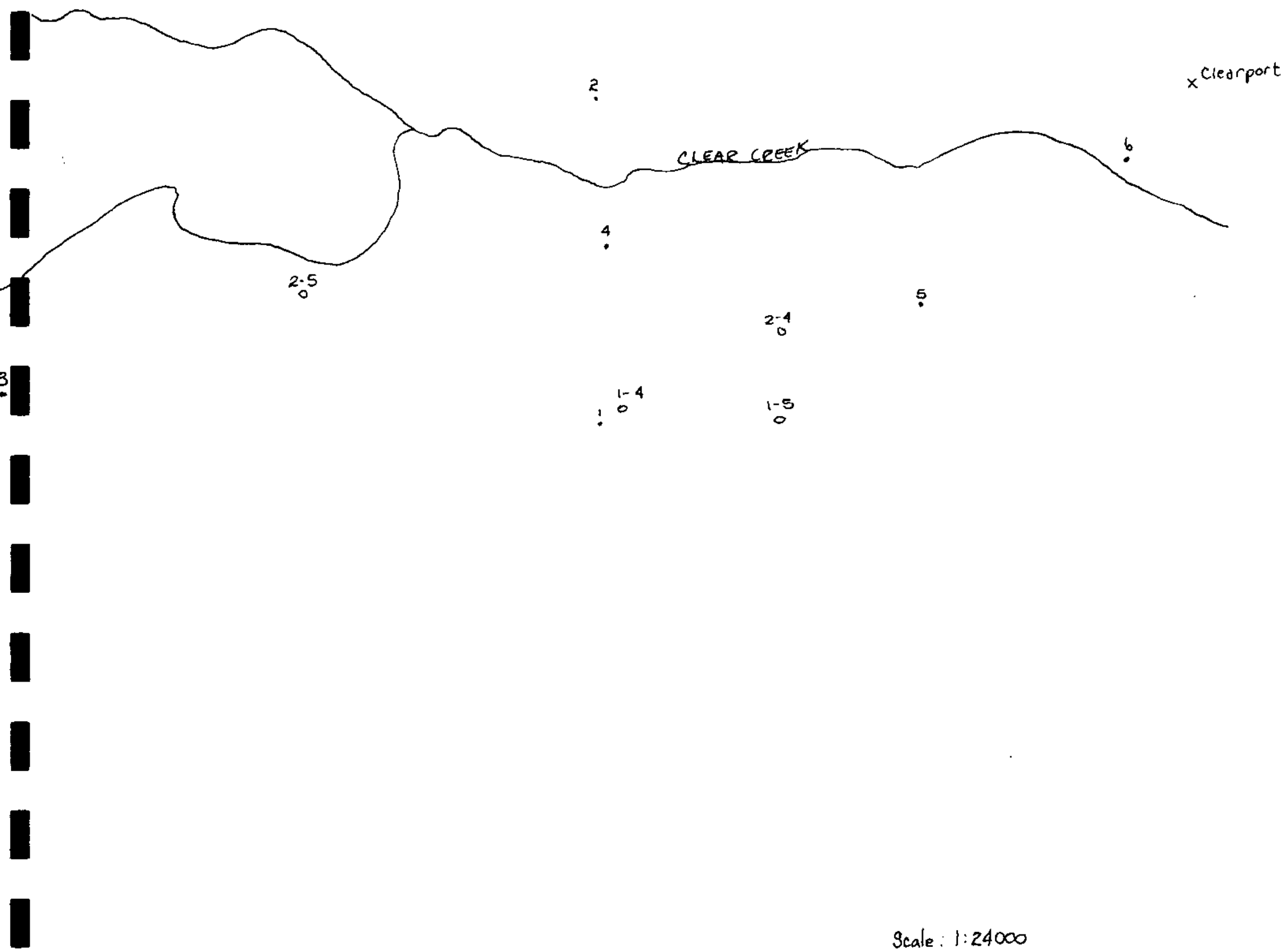
a.

b.

c.

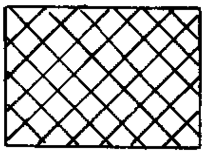
6. Algiers Silt Loam
Note well developed structure
a. Friable Silt Loam
b. Firm Silty Clay Loam
c. Very Firm Silty Clay, Mottled with yellowish brown silty clay

Quick reference of core locations for sections 1 and 2

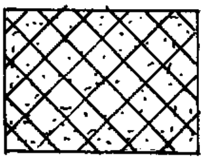


Legend

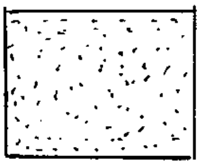
Soil



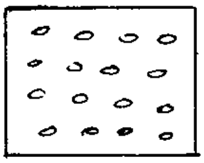
Clay



Silty Clay



Sand

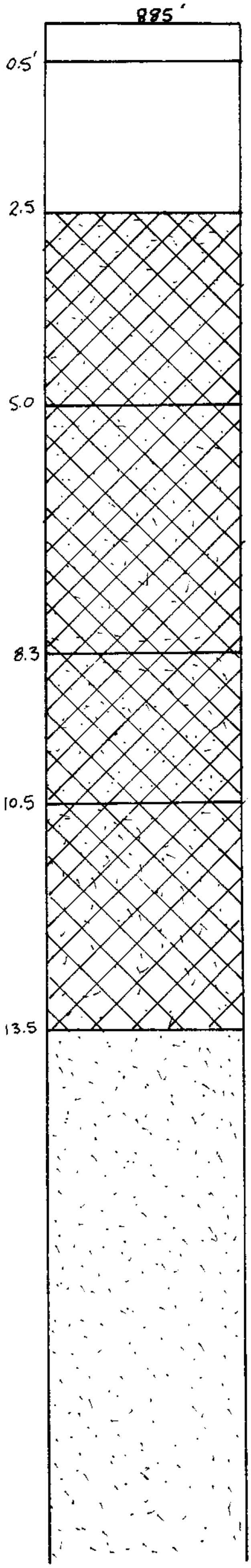


Gravel

Section I: Data derived from the use of the Jeep mounted auger.

Scale: 1" = 2'

Core 1-4-10



Westland Silty Clay Loam

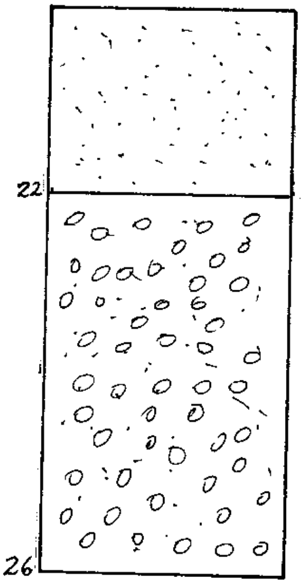
2.5-5' Silty Clay, 10YR 5/4, calcareous,small pebbles

5-8.3' Silty Clay, 10YR 4/3, calcareous

8.3-10.5' Silty Clay, 6BG 7/1

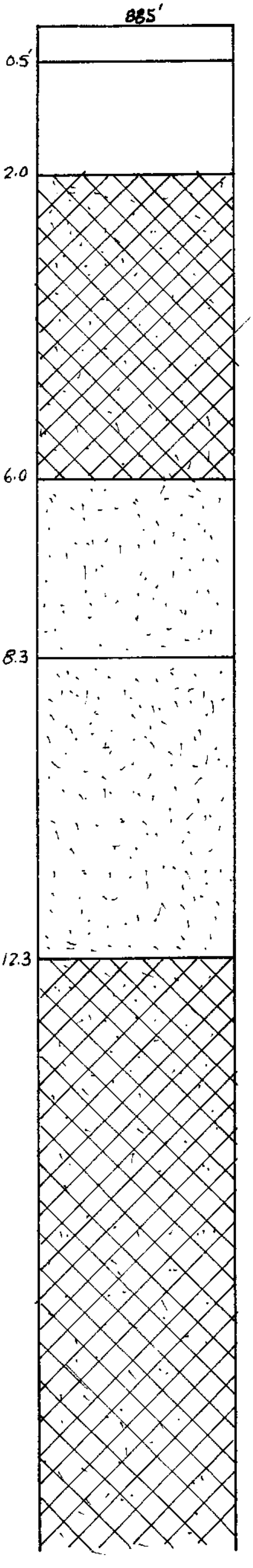
10.5-13.5 Silty Clay, 10YR 5/2

13.5-22' no sample,Sand(?)



22-26' Gravel

Core 2-4-10
Montgomery Silty Clay Loam

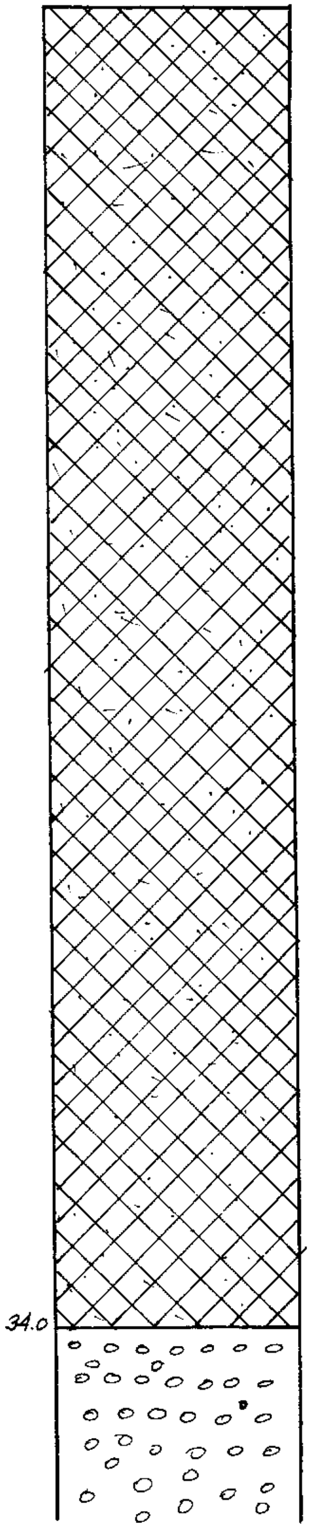


2-6' Silty Clay,10YR 5/4,blocky

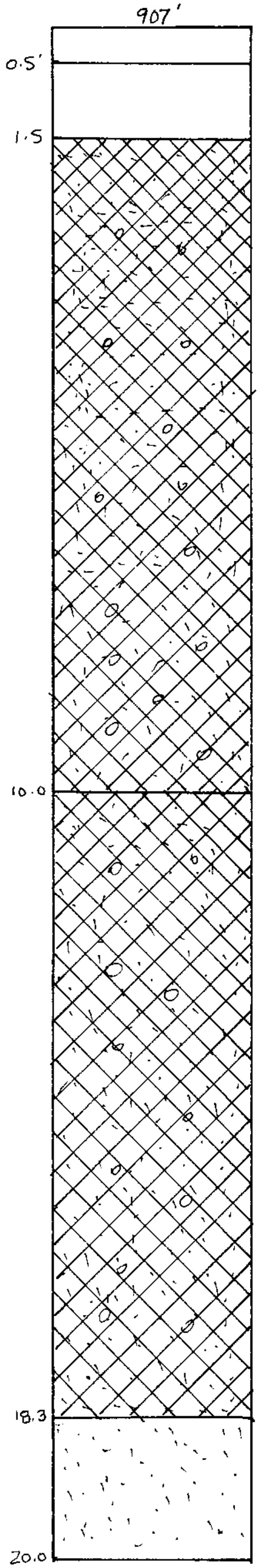
6-8.3' Sand,fine grained,very cohesive,10YR 5/5, coarser with depth

8.3-12.3' Sand, coarse,not cohesive except wet

12.3-34' Silty Clay,10YR 4/1,color changing slowly with depth to 10YR 5/2



34-38' Gravel



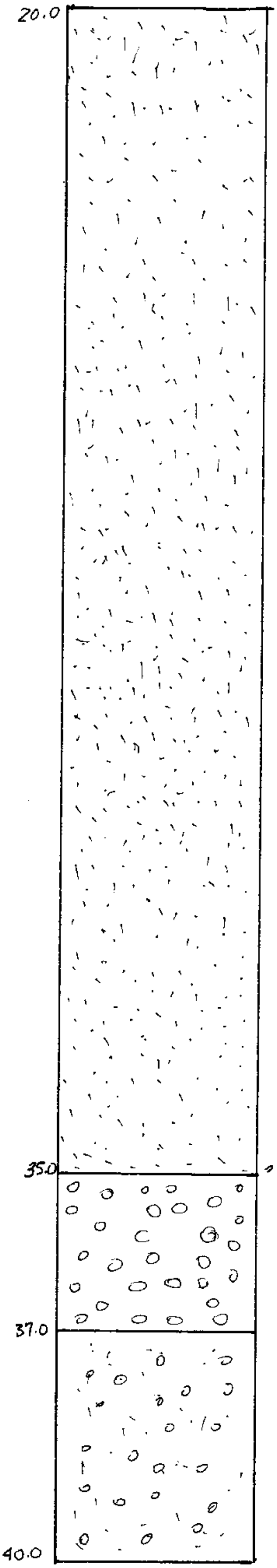
Core 1-5-10

Montgomery Silty Clay Loam

1.5-10' Silty clay, some small pebbles, sub-angular to well rounded, 10YR 5/3

10-18.3' Silty clay, 7.5YR n5/, blocky, some small pebbles

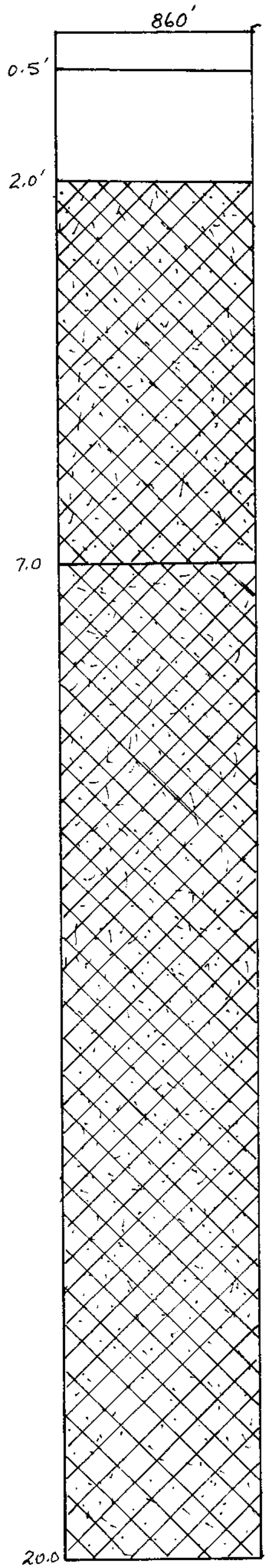
18.3-20' Sand



20-35' Sand

35-37' Gravel

37-40' Sand and gravel

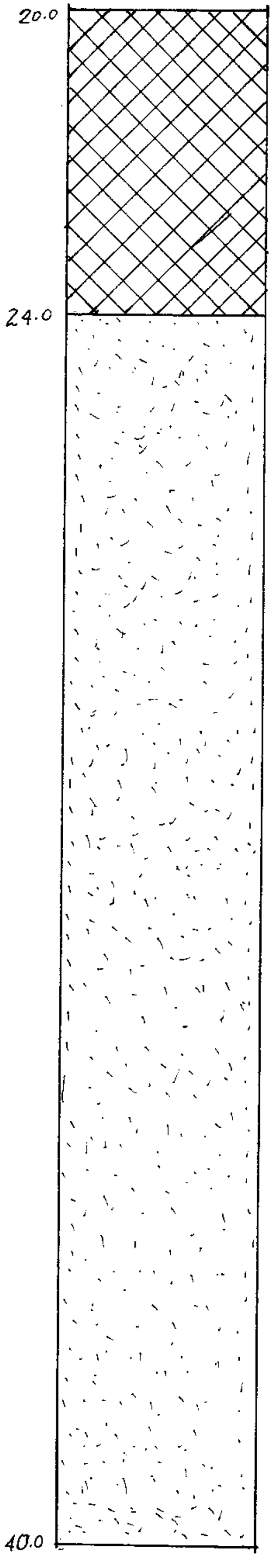


Core 2-5-10

Montgomery Silty Clay Loam

2-7' Silty clay, 10YR 7/8, slightly calcareous, laminated

7-20' Silty clay, 10YR 5/3, laminated

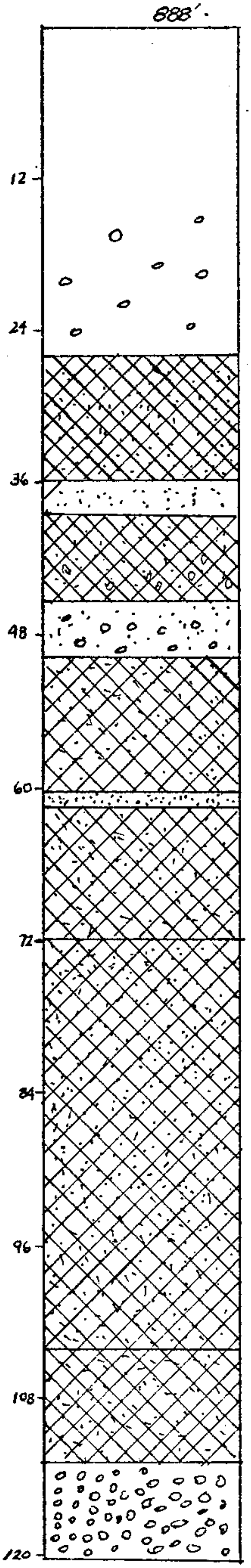


20-24' Gray clay, moderately calcareous, till?

24-40' Sand, no sample

Section II: Data derived from hand coring

Scale: 1" = 1'



Core #1

0-27 Soil Montgomery Sily Clay Loam
some small pebbles

27-36 Silty Clay, 20% silt, yellowish brown, blocky

36-40 Sand, white to gray, medium coarse

40-45 Silty Clay, 30% silt, gray, some pebbles

45-49 Sand and gravel, subangular to rounded, sandstone and limestone

49-60 Silty Clay, gray

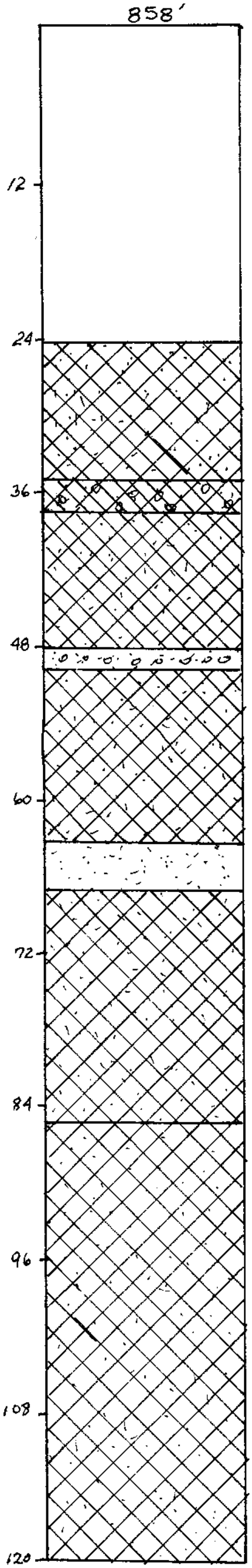
60-62 Sand

62-71 Silty Clay, gray, 40% silt, calcareous

71-105 Silty Clay, dark gray, decreasing silt content with depth, some small sand lenses

105-115 Silty Clay, dark grey, pebble content increasing with depth

115-120 Gravel, no sample



Core 2

0-24 Soil Montgomery Silty Clay Loam

24-35 Silty Clay, yellow-brown, some small pebbles

35-38 Silty Clay, dark-brown, some pebbles

38-48 Silty Clay, gray, lamininated

48-50 Sand and gravel

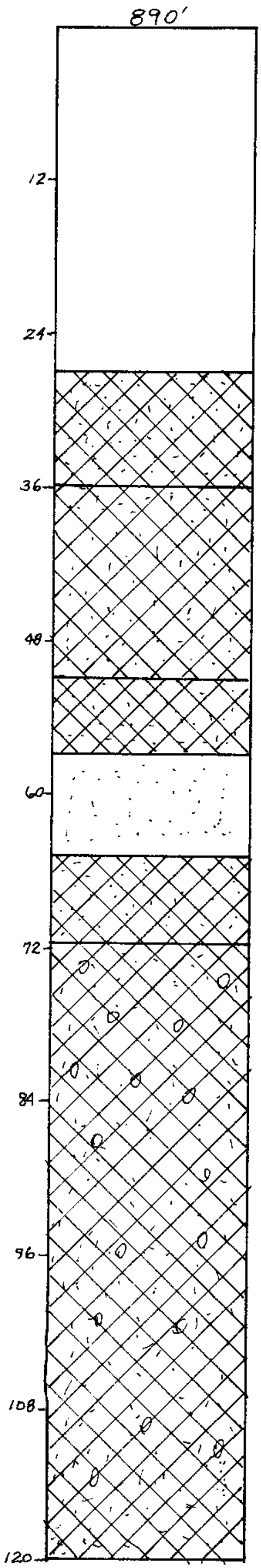
50-63 Silty Clay, gray

63-66 Sand

66-85 Silty Clay, gray, laminated, mollusk shells

85-120 Silty Clay, gray, some sand lenses randomly distributed

Core 3



0-26 Soil Montgomery Silty Clay Loam

26-36 Silty Clay, yellow brown

36-50 Silty Clay, brown

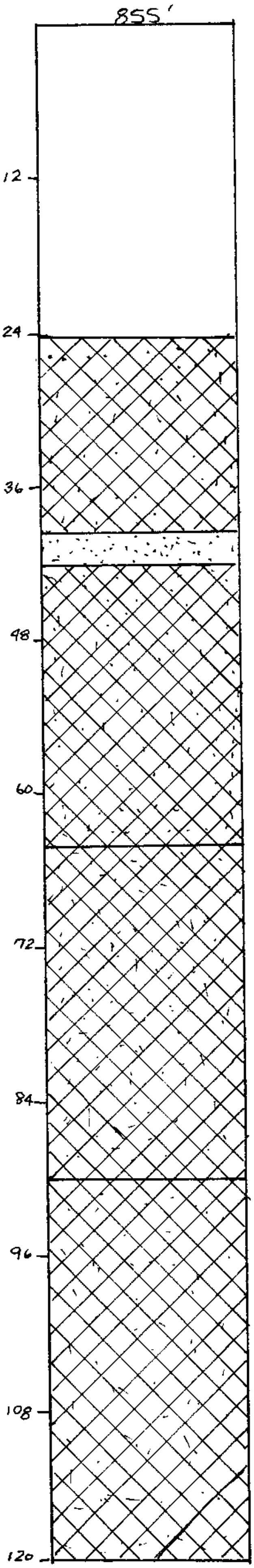
50-58 Silty Clay, gray

58-65 Sand

65-72 Silty Clay, gray

72-120 Silty Clay, gray, small rock fragments composed of sandstone and limestone

Core 4



0-24 Soil McGary Silt Loam

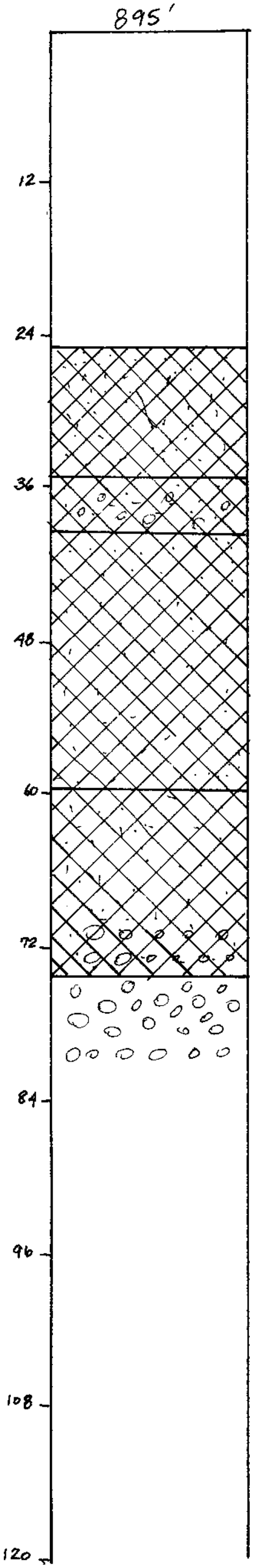
24-40 Silty Clay, yellow brown, becoming darker with depth

40-42 Sand

42-65 Silty Clay, brown

65-90 Silty Clay, gray-brown

90-120 Silty Clay, gray



Core 5

0-25 Soil Montgomery Silty Clay Loam

25-35 Silty Clay, gray, becoming more silty with depth

35-40 Silty Clay, gray, some small sandstone pebbles

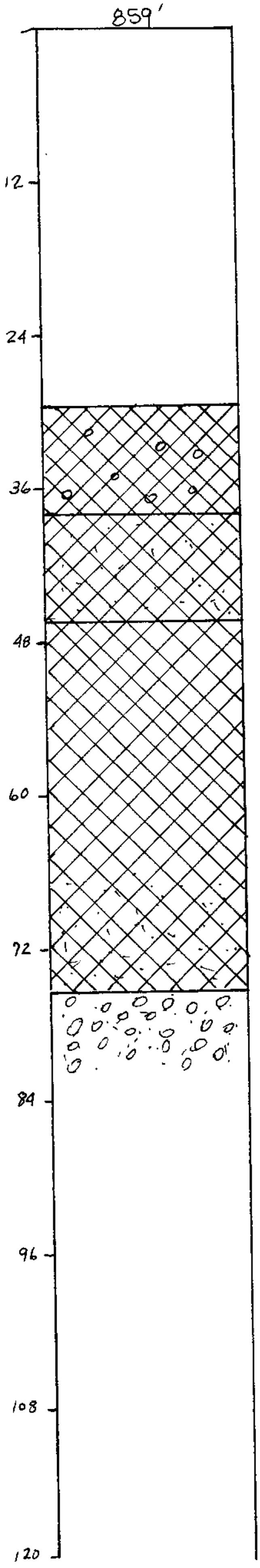
40-60 Silty Clay, gray

60-75 Silty Clay, gray, some small sandstone pebbles number and size increasing with depth

75-80 Gravel, no sample

Page 38 is missing from the original 1969 Senior Thesis by Michael Mitchell.

Core 6



0-29 Soil Westland Silty Clay Loam

29-38 Clay,gray, some small pebbles

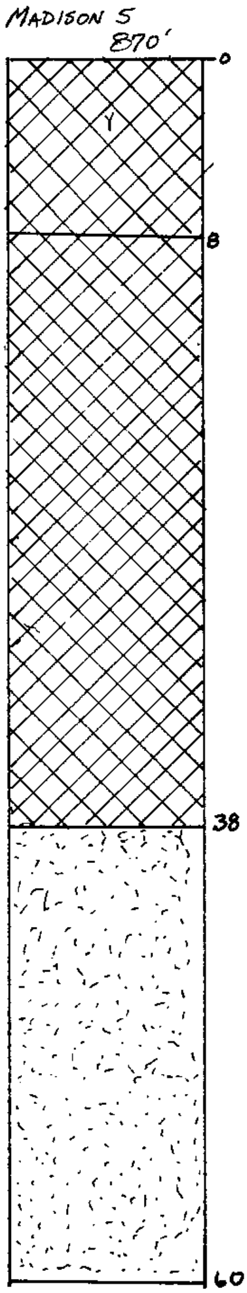
38-45 Sandy Clay,yellow-brown

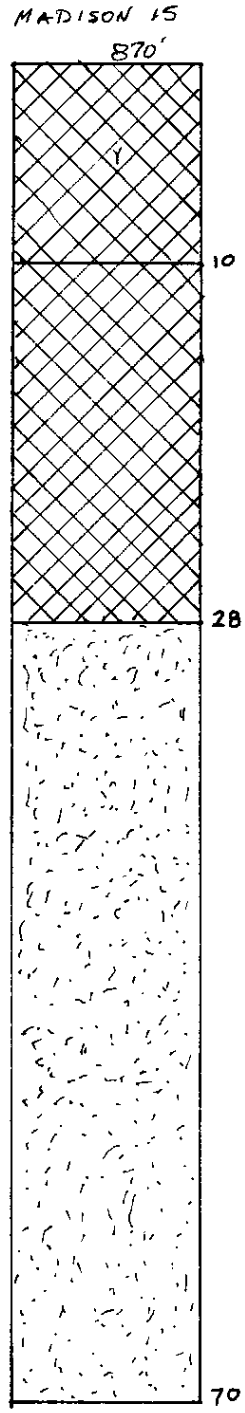
45-74 Clay,gray, becoming silty with depth

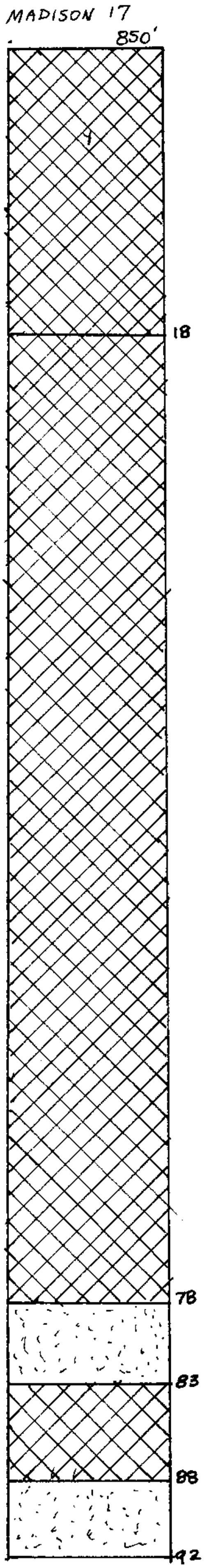
74-80 Gravel and sand,no sample

Section III: Data derived from well logs

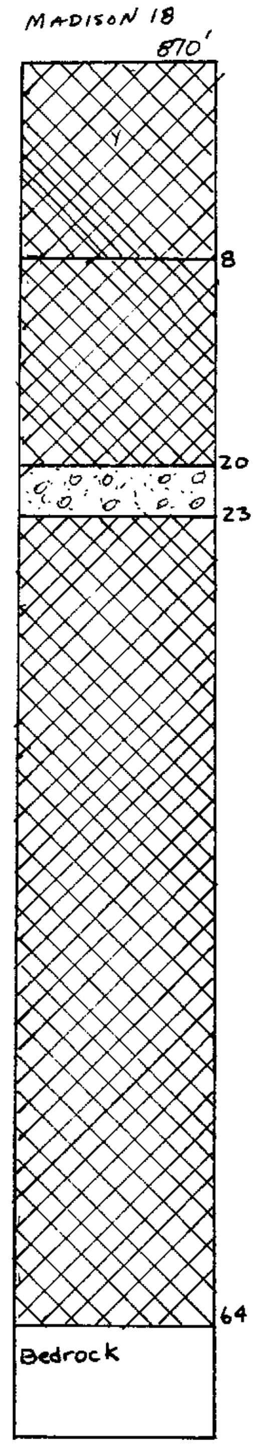
Scale: 1" = 10'


MADISON 5
870'
0
Y
8
38
60


MADISON 15
870'
Y
10
28
70

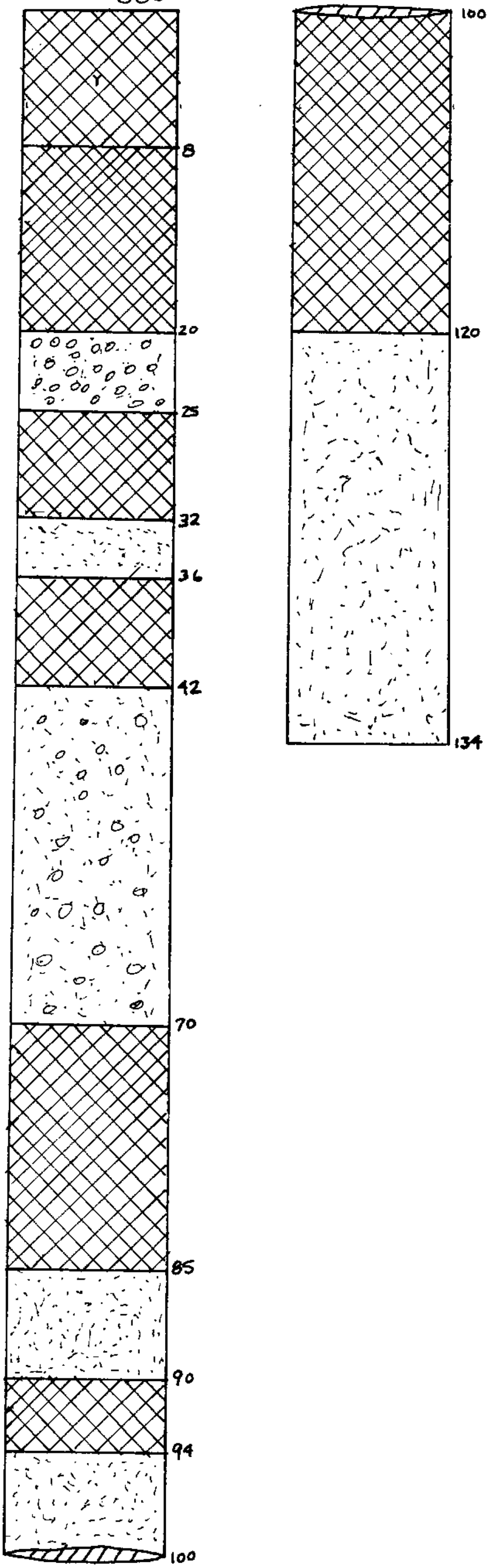


MADISON 17
850'
18
78
83
88
92

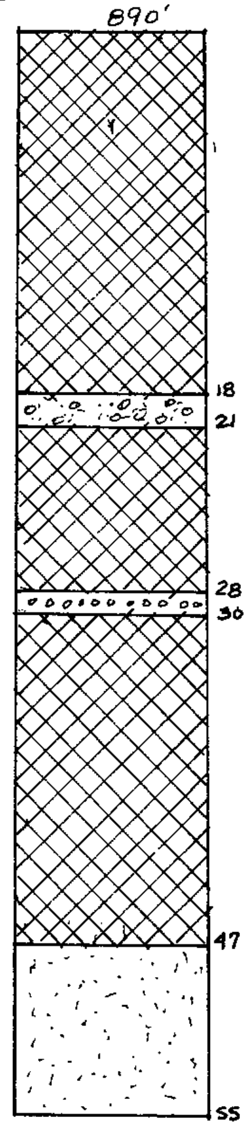


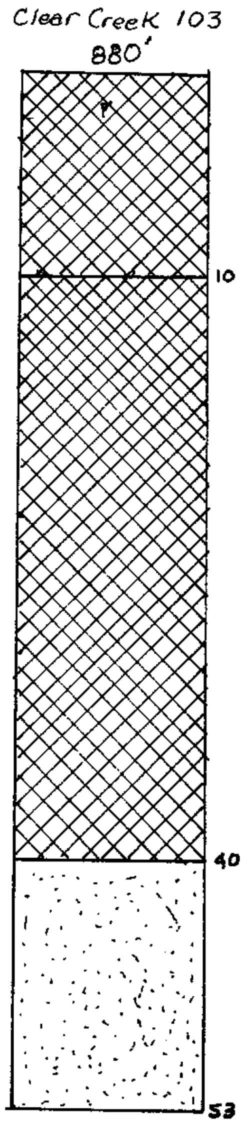
MADISON 18
870'
8
20
23
64
Bedrock

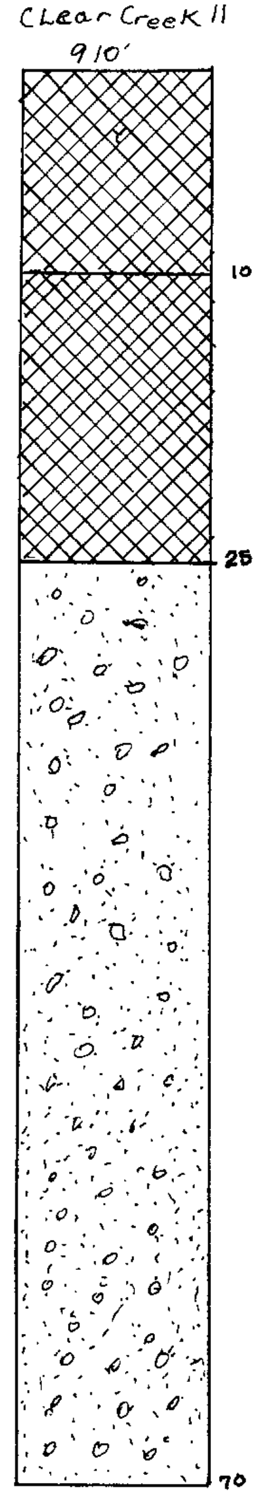
Clear Creek 84
885'

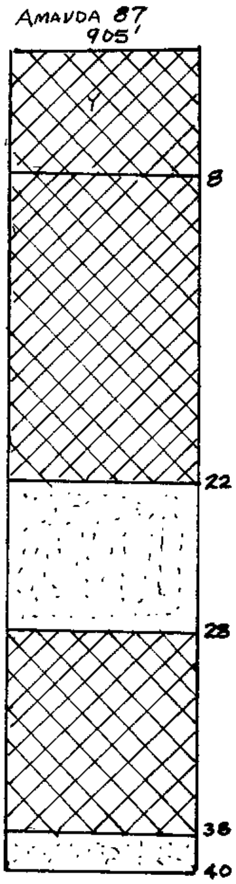


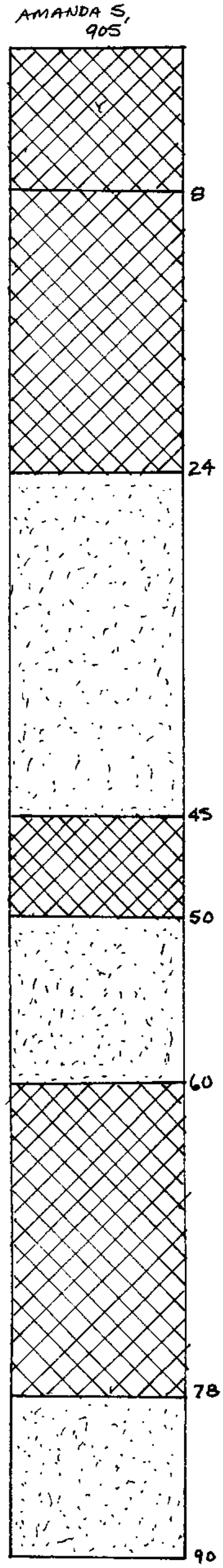
CLEAR CREEK 106
890'




Clear Creek 103
880'
10
40
53


Clear Creek 11
910'
10
25
70


AMANDA 87
905'
Y
8
22
28
38
40


AMANDA S,
905'
Y
8
24
45
50
60
78
90

Gastropods in the lake silts

Gastropods were collected at two sites in the area: in a stream cut along Clear Creek at a depth of 7 feet, and in core 2.

The fragments of the larger molluscs were impossible to identify. The smaller shells were identified by Dr. Aurèle La Rocque, Department of Geology, Ohio State University.

Several examples of Goniobasis livescens, Sphaerium, and Valvata tricarinata were collected at each site.

Goniobasis livescens occurs in shallow fresh water, in up to nine meters of water. It is found in rivers and lakes with or without vegetation on sand, gravel, clay or mud bottoms. The range of this species is Middle Pleistocene to Recent and is quite common in Pleistocene lacustrine deposits.

Sphaeruim is also a shallow fresh water form and has the same habitat and range as Goniobasis livescens, as does Valvata tricarinata.

The ecology, age range and the areas of collection of these mollusc shells substantiates the claim that this area was once covered by a shallow, fresh water Pleistocene lake.

Conclusions

The Clear Creek Valley between Clearport and Amanda was filled by a late Pleistocene lake, which deposited an average thickness of 18 feet of silts and clays.

The soil groups, Montgomery, Westland, McGary, Fitchville, and Carlisle were developed on these stratified or nonstratified lake silts.

The data obtained from deep well logs indicates that the majority of the material in the Clear Creek Valley consists of lake deposits interbedded with coarser deposits which shows that several lakes probably existed in this valley during the Pleistocene.

The Mollusc species in some of the sediments also indicates that there was a late Pleistocene lake of fresh water in this valley.

Detailed work is needed to determine any exact stratigaphic relationships. However, an examination of the cores shows a definite decrease in sediment coarseness as one travels away from the outwash dam and away from the sides of the lake. The layering in some of the clays probably represents seasonal changes or varves.

References Cited

Meeker, R.L., Petro, J.H., Bone, S.W., 1960 Soil Survey of Fairfield County, Ohio. USDA, Series 1951, No. 7.

Merrill, W.M., Pleistocene History of a Part of the Hocking River Valley, Ohio. Geological Survey of Ohio, Report of Investigations 16.

Stout, W., Ver Steeg, K., Lamb, G.F., 1943 Geology of Water in Ohio. Geological Survey of Ohio, Bull 44.

Wolfe, E.W. Forsyth, J.L. Dove, G.D., 1962 Geology of Fairfield County. Geological Survey of Ohio, Bull 60.